

DIAGNOSIS AND MANAGEMENT OF A PATENT URACHUS IN A WHITE RHINOCEROS CALF (*CERATOTHERIUM SIMUM SIMUM*)

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Abstract: A 10-day-old female southern white rhinoceros calf (*Ceratotherium simum simum*) was diagnosed with a patent urachus after urine was observed dribbling from the umbilicus. After being separated from its mother, the animal was sedated with i.m. butorphanol and anesthetized with isoflurane in oxygen for surgical correction of the patent urachus. Mild postoperative complications involved seroma formation and partial skin incision dehiscence, which necessitated three follow-up immobilizations for reevaluation and treatment of the surgical site. Histopathology did not reveal an infectious etiology as the cause for the complications or for the patent urachus. The etiology of the patent urachus in this animal remains undetermined. This report represents the first documented case of a patent urachus in a white rhinoceros.

Key words: Rhinoceros, *Ceratotherium simum simum*, patent urachus, congenital defect.

INTRODUCTION

Patent urachus is a congenital or acquired defect that results when the embryonic connection between the bladder and allantoic sac fails to close after birth.^{9,11,12} This condition is commonly diagnosed in domestic foals and occasionally in calves.^{6,14} Frequently, a patent urachus is accompanied by omphalitis, omphalophlebitis, and urachitis, with inflammation and infection extending to the abdominal structures.^{1,5,6,14} This is the first report documenting the diagnosis and management of a patent urachus in a white rhinoceros (*Ceratotherium simum simum*).

CASE REPORT

Clinical history

A 10-day-old female southern white rhinoceros calf, born at the Knoxville Zoological Gardens, appeared agitated and was kicking and extending its hind legs in an unusual fashion. The animal's abnormal behavior prompted closer examination, during which urine was observed intermittently dribbling from the calf's umbilical area. Prior to this observation, the calf had been seen urinating normally, and no dribbling from the umbilicus had been noted. The calf and its 30-yr-old mother were separated from the herd 2 days after the dribbling was observed. The cow was estimated to weigh

2,000 kg and was sedated with an i.m. combination of etorphine (M99®, Lemmon Co., Sellersville, Pennsylvania 18960, USA; 0.25 µg/kg) and xylazine (The Butler Company, Columbus, Ohio 43228, USA; 0.05 mg/kg) administered via a remote drug-delivery system (Cap-Chur, Palmer Chemical & Equipment Co., Douglasville, Georgia 30133, USA), followed by a second i.m. dose of the same drug combination after 20 min. To facilitate separating the calf, the cow required an additional 0.5 µg/kg etorphine i.m. 37 min after the initial dose. The calf was hand injected with i.m. butorphanol (Torbugesic®, Fort Dodge Animal Health, Fort Dodge, Iowa 50501, USA; 0.17 mg/kg) once it was separated from the cow. This dose provided sufficient sedation to walk the calf into a transport vehicle and to allow mask induction of anesthesia by mask using isoflurane (AErrane®, Fort Dodge Animal Health). Following induction, the calf was intubated with a 12-mm cuffed endotracheal tube and was maintained on 1.5–2.5% isoflurane in oxygen. Intermittent positive pressure ventilation was administered for the duration of the procedure, which lasted approximately 1 hr. Heart rate, respiratory rate, rectal body temperature, end-tidal CO₂, and relative arterial oxygen saturation were monitored continuously.

On physical examination, the calf was in good body condition, weighing 89.4 kg. Heart and respiratory rates before induction of anesthesia were 100 beats/min and 40 breaths/min, respectively. The umbilicus was moist and had a 1-cm circular hyperemic area of skin around a 3-mm opening (Fig. 1). A sterile probe could easily be inserted and advanced into the umbilical opening from which fluid flowed intermittently. There was no evidence of swelling or heat around the umbilical

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Figure 1. The umbilicus of a 10-day-old white rhinoceros with a patent urachus.

area. Physical examination of the mother under sedation revealed no abnormalities. Blood samples from both animals were taken for complete blood counts (CBCs), serum biochemical analysis, and electrolyte evaluation. All results for both animals were within reference values for this species.⁷

An ultrasound examination using a 5-mHz transducer (Aloka SSD-500V, Aloka Co., Wallingford, Connecticut 06492, USA) was performed on the calf to evaluate the umbilicus and the associated abdominal structures. The umbilical vein was visualized traversing toward the cranial abdomen. The urachus and paired umbilical arteries were identified and followed to their union with the bladder. The urachus appeared dilated, but the umbilical arteries were considered within normal limits compared with those previously observed in domestic foals of the same age. No evidence of omphalophlebitis was observed.

Surgery

A 20-ga i.v. catheter was placed into the left radial vein, and lactated Ringer's solution USP (Abbott Laboratories, North Chicago, Illinois 60064, USA) was administered at a rate of 5 ml/kg/hr i.v. during the procedure. The animal was given an s.c. injection of a penicillin G benzathine/penicillin G procaine suspension (Flo-cillin®, Fort Dodge Animal Health; 4,027 IU/kg) and i.v. amikacin (Amiglyde-V®, Fort Dodge Animal Health; 2.2 mg/kg) prior to surgery. The calf was placed in dorsal recumbency, and the ventral abdomen was routinely prepared for a ventral midline laparotomy. A 10-cm elliptical ventral midline skin incision was made around the umbilicus and extended to the abdomi-

nal wall. Traction was applied to the umbilicus and an elliptical incision was made around the umbilical stump at its insertion in the abdominal wall. Once the abdominal cavity was entered, the linea alba was digitally palpated to check for the presence of adhesions. None were found, and the incision through the linea alba was extended both cranially and caudally. The umbilical vein and arteries were identified and examined. No abnormalities were detected. The vessels were double ligated with 0 polyglactin 910 (Vicryl™, Ethicon, Somerville, New Jersey 08876, USA) and transected distal to both ligatures. Tension on the umbilical stump facilitated dissection of a tubular band of tissue extending from the umbilicus to the urinary bladder (Fig. 2). Stay sutures of 0 polyglactin 910 were placed on each side of the bladder apex to facilitate manipulation of the bladder. Doyen intestinal forceps were placed across the apex of the bladder distal to the stay sutures. The patent urachus and associated structures were amputated just proximal to the Doyen intestinal forceps to prevent contamination of the abdominal cavity with any material that may have been contained within the urachus. The stay sutures were used to elevate the bladder incision to prevent urine from leaking into the abdomen. The bladder defect was closed using 2-0 polyglactin 910 in a simple continuous pattern oversewn with a continuous Cushing pattern using the same suture material. The linea alba was apposed with 0 polyglactin 910 in an interrupted cruciate pattern, and the subcutaneous tissues were closed with 2-0 polyglactin 910 in a simple continuous pattern. The skin was apposed with 1 polyglactin 910 in an interrupted horizontal mattress pattern.



Figure 2. Dissected patent urachus of a white rhinoceros calf during surgical correction.

Samples from the excised umbilicus and urachus were submitted for anaerobic, aerobic, and fungal culture and histopathologic evaluation. Fungal culture yielded no growth at 6 wk. Moderate numbers of mixed gram-positive and gram-negative bacteria were isolated. Histologic examination of the umbilicus and urachus revealed no evidence of infection or etiologic agents. The organisms identified by culture were considered contaminants. A urine sample, taken by cystocentesis during surgery, was also submitted for urinalysis and was normal.

Postoperative care

The calf recovered from anesthesia uneventfully, and normal urination, without dribbling, was noted within 4 hr after surgery. In an effort to prevent the cow from rejecting the calf, the cow's feces were rubbed on the calf's back to mask any unusual scents from surgery and human handling. Once the calf was standing and fully recovered from anesthesia, the cow was administered the opioid antagonist naltrexone (Trexonil™, Wildlife Laboratories, Fort Collins, Colorado 80524, USA; 0.05 mg/kg i.v., 0.05 mg/kg i.m.) and was reintroduced to the calf after several minutes. The reintroduction proceeded without complications, and the calf was seen nursing several hours later. The cow and calf were maintained in a barn with concrete floors to

keep the calf's incision cleaner than would be possible in their outdoor soil enclosure.

Eight days after surgery, the calf was sedated and separated from the cow in a similar manner as previously described to evaluate the surgical site. On examination, there was a moderately firm swelling along the entire length of the calf's incision and two isolated seromas, one at each end of the incision. The small (1 × 2 cm) caudal seroma was monitored and resolved without further treatment. The larger (3 × 3 cm) cranial seroma was associated with a 1-cm area of skin incision dehiscence. Several skin sutures were removed, allowing the larger seroma to be opened. A Penrose drain was sutured in place to facilitate drainage. Swabs from the seroma were submitted for anaerobic and aerobic culture, which yielded moderate growth of mixed bacteria consistent with fecal and skin contaminants. The calf received 0.5 ml tetanus toxoid (Fort Dodge Animal Health) and 1.0 ml killed rabies vaccine (Imrab®, Rhone Merieux, Athens, Georgia 30601, USA) i.m., in addition to s.c. penicillin G benzathine/penicillin G procaine suspension (4,027 IU/kg). The calf's butorphanol sedation was antagonized with 0.06 mg/kg naltrexone i.m. and 0.01 mg/kg naloxone (Narcan®, Endo Pharmaceuticals, Chadds Ford, Pennsylvania 19317, USA) i.m. by hand injection. The cow's sedation was reversed, and the cow was reintroduced to the calf as previously described.

Two days after the placement of the Penrose drain (10 days after surgery), the cow and calf were sedated to reevaluate the incision. The larger seroma was resolving, so the drain was removed and the wound was flushed with copious amounts of a 1:40 dilution of chlorhexidine solution (Nolvasan®, Fort Dodge Animal Health) in sterile saline. The wound edges were debrided with a no. 10 scalpel blade. There was still firm swelling along the entire length of the incision that, after careful palpation, was presumed to be the body wall reaction to the sutures. The calf was given 4,027 IU/kg penicillin G benzathine/penicillin G procaine suspension s.c. and 0.06 mg/kg naltrexone and 0.01 mg/kg naloxone i.m. A venous blood sample submitted for a CBC and biochemical analysis revealed a mild increase in white blood cells (WBC) from 8.5×10^3 cells/ μ l preoperatively to 15.8×10^3 cells/ μ l, which was still considered within normal limits for 10 days after surgery (reference WBC = 4.7–15.5 × 10^3 cells/ μ l⁷).

The last physical examination of the calf was done 13 days postoperatively. The calf was active, had a good appetite, and appeared to be gaining weight. The cow and calf were sedated and separated as before. On physical examination of the

calf, the seroma had resolved and the wound was healing by secondary intention. The area was cleaned and irrigated with dilute chlorhexidine solution as previously described. The remaining skin sutures were left to be absorbed. The calf received its last injection of 4,027 IU/kg penicillin G benzathine/penicillin G procaine suspension i.m. A blood sample was submitted for a CBC, and results were within reference ranges.⁷

Following recovery from sedation, the cow and calf were returned to the herd in their outdoor group enclosure. Visual observations to monitor the cow and calf continued for 3.5 wk following the last sedation and physical examination. No unusual behavior was observed during that time. At 1.5 yr of age, the calf is thriving.

DISCUSSION

The urachus is a channel that communicates between the fetal urinary bladder and the allantoic sac during embryonic development. It allows fetal urine to pass from the urinary bladder to the placenta, where metabolites are absorbed by maternal circulation.¹² After birth, this connection becomes fibrotic and atrophies. In domestic animals, it is common to see a remnant scar on the bladder where the urachus existed at one time.^{12,13} In humans, a ligament forms as the urachus becomes fibrotic.^{2,12}

A patent urachus exists when this channel does not fibrose properly after birth. There are varying degrees of patent urachus, which can include cyst or diverticulum formation or subcutaneous leakage of urine.¹² Reported causes of patent urachus include congenital, infection (omphalitis),^{3,14} urethral blockage, and rupture of the umbilical cord too close to the abdominal wall.^{6,11} The incidence of patent urachus varies with species. Failure of the urachus to close at birth most commonly occurs in domestic foals and is often associated with omphalitis in bovine calves.^{5,14} Patent urachus is rare in dogs and cats¹³ and has been reported in a walrus, a nilgai, and a few other exotic animal species.^{1,4,8}

Clinical signs in this rhinoceros calf were consistent with those observed in domestic animals. The primary sign is moistening of the umbilical stalk or dribbling of urine from the umbilicus.¹⁴ Occasionally, an enlarged urinary bladder is noted on abdominal palpation. Diagnosis is most commonly based on clinical signs; however, ultrasound examination,^{3,10} cystoscopy, and radiographic contrast studies have also been used.^{11,14} Surgical intervention is the preferred treatment, although cauterizing agents (tincture of iodine or silver nitrate) have been used successfully.^{11,14} The prognosis is good

to fair with early intervention but can be guarded to poor with extensive omphalitis and septicemia.¹⁴

To our knowledge, this is the first case of a patent urachus reported in a rhinoceros. Although there is debate regarding the etiopathology of patent urachus, the possibility of it being a congenital defect has been presented.^{11,14} Congenital defects have rarely been reported in rhinoceros.¹⁵ The long-term health implications of a potentially congenital defect for individuals and the future genetic impact on the species are unknown. Despite thorough investigation, the etiology of this calf's patent urachus still remains undetermined; is unclear whether it was due to a developmental anomaly, an unidentified infectious etiology, or perhaps rupture of the umbilicus too close to the abdominal wall. No gross or histologic evidence of omphalitis or other infection was identified.

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